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September 30, 1965.

Subject: Progress Report for Research Grant NsG 388

Title of Project: "Study of the Dynamics of Cerebral Circulation by Continuous Rheoencephalographic Monitoring"

Report Period: June 16, 1964 to June 30, 1965.

Personnel:

Principal Investigator:

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Other Investigators:

W.E. Kucharski, M.D., - Research Associate
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M. Cattaro - Consulting Physicist
J. McWilliams Jr., - part-time Physicist
Fritz L. Jenkner, M.D., - Visiting Research Associate (9/16/64 - 10/30/64)
W.J. Thaler, Ph.D., - Consulting Physicist
R.Z. Zakowski Lind, V.M.D., - Medical Assistant
T.M. Nalecz - Research Secretary

Note: The Principal Investigator wishes to disassociate himself entirely from any statements made by Dr. John H. Seipel on the subject of Project NsG 388. A report on Dr. Seipel's activities was submitted to NASA on August 12, 1964.

Dr. Jenkner from Graz, Austria, visited our laboratory in Georgetown for 6 weeks in the fall of 1964 (Sept.16, 1964 - Oct. 30, 1964). Dr. Jenkner is the author of the first English monograph on Rheoencephalography and the originator of the term.

List of publications and papers in 1964-1965:

A. Publications:

1. Ziemnowicz, S.A.R., "The present status of standard and regional rheoencephalography R.E.G.)" in: Fourth Princeton Conference on Cerebrovascular Diseases 74-80,83,85,111,127; Grune & Stratton, New York, 1965.

2. Ziemnowicz, S.A.R., "Rheographic regional method for evaluation of cerebral and ocular circulation in cardiac and cerebrovascular disease" J. Amer. Geriatrics Soc. 13; 35-43, Jan. 1965.

3. Ziemnowicz, S.A.R., "Rheoencephalography (R.E.G.): a diagnostic method for the study of cerebral circulation dynamics. I. Principles and application." Chapter in: Methods in Psychophysiology, Ed. Clinton C. Brown. Williams & Wilkins, Baltimore, Md. (in press).

B. Papers:

1. Ziemnowicz, S.A.R., "Regional rheoencephalography (R.R.E.G.) applied in aeromedical selection and as an early warning device"-Presented at the 13th International Congress of Aviation and Space Medicine, Sept. 1964 in Dublin, Ireland.

2. Ziemnowicz, S.A.R. with Mc Williams J. Jr., and Kucharski, W.E., "Remarks on electrical field distribution in standard hemispherical R.E.G. and in regional rheoencephalography (R.R.E.G.)"

and

3. "Conductivity versus frequency in human and feline cerebrospinal fluid" - - presented at the 17th Annual Conference on Engineering in Medicine and Biology, Cleveland, O., Nov. 1964. Proceedings; 17; 29 & 108.

4. Ziemnowicz, S.A.R., "Biological Age reflected in cerebral circulation: - a regional rheoencephalographic study" - presented at the 22nd Annual Meeting of Amer. Geriatrics Soc., New York, June 1965.

5. Ziemnowicz, S.A.R., "Intravertebral resorption in the treatment of communicating hydrocephalus" - abstract in Sectio Neurochirurgiae, Congressus Chirurgicus, July 1965, Bratislava, Czechoslovakia. The author was unable to attend.

6. Ziemnowicz, S.A.R., "Rheoencephalographic study after craniocerebral trauma: - diagnostic and prognostic evaluation" - presented at the 8th International Congress of Neurology, Vienna, Austria, September 1965, Excerpta Med. 94;E51.72.

7. Ziemnowicz, S.A.R., abstract: "Standard and regional rheoencephalographic studies in neurotraumatology" - Excerpta Medica, Int. Congress series 93; 194, 1965

8. Ziemnowicz, S.A.R., abstract: "Experimental and clinical value of transient local ischemization of the brain (topischemia)" - Excerpta Medica, International Congress series 93; 230, 1965.

Participation in Discussions:

This Investigator took part in the discussions on basic and applied aspects of rheoencephalography at the 5th International Congress of Angiology in Paris, September 1964 and at the Scandinavian Congress of Neurosurgery in Oslo, Norway, September 1964. He participated in the discussions at the Congress of Neurosurgery in Copenhagen, Denmark in August 1965 and at the advanced E.E.G. Course in Salzburg, Austria, in September 1965.

Results:

NASA grant NsG 388 permitted this investigator and his collaborators to improve the stability and sensitivity as well as adjustment for capacitance and resistance of the rheographic apparatuses used in their work. They devised an original placement and geometry of scalp electrodes and improved skin contact. Confrontation and comparison with the equipment, technique and results of American and foreign investigators indicate that our work, experimental and clinical, is superior and more advanced. We were able to obtain better and more reliable tracings of intracranial cerebral pulsations and introduce a new technique of monitoring circulatory changes in small segments of the brain. This innovation, already mentioned in the initial grant application, was elaborated further, mostly before and after brain surgery on experimental animals and clinical cases. We have coined the term "regional" rheoencephalography (R.R.E.G.) for the method described in papers and publications. This method markedly increases the diagnostic possibilities of early disclosure of pathology in cerebral circulation. Initial standards for equipment, application and interpretation were prepared.

Conclusions:

Personal contacts and discussions with American and foreign scientists, point to the fact that this Investigator's work in rheoencephalography has contributed more to this particular field than the work of any other center or country. Cranial rheography or rheoencephalography is studied in fewer centers than the rheographic impedance of the extremities, heart, lungs and other organs. Work on cranial rheography is hampered by difficulties in comparing results. They are due to widely differing equipment, mostly custom-built and unsuitable (e.g. the U.S.A., some centers in Austria, Italy, Japan and Russia). The lack of standardization and proper technique add to the confusion. This state of affairs was described by this Investigator at the last international congresses of Neurological Surgery, Neurology and E.E.G. & Clinical Neurophysiology in the summer of 1965.

Further research should be pursued in the direction of applied physics, especially in quantitation of biophysical parameters obtained by continuous rheoencephalographic oscillation in impedance and conductivity. The usual calibration of 100 miliohms on 10 milimeters permits to compare bilaterally, symmetrical derivations in the following sequence: hemispherical, frontal, temporal, parietal and occipital. A modification of the existing mathematical equations for a cylindical conductor with uniform conductivity was necessary for comparison of continuous pulsation in a living tissue volume in a given a.c. field. Further work should also be pursued on a.c. field distribution from two and four sources in

the living brain and correlation with other flow measurement methods.

According to information which this Investigator obtained in June and September 1965, at present only the Russians are applying our method and technique of regional rheoencephalography. They came to the conclusion that it is a much more valuable tool than the previous hemispherical rheoencephalographic examination. It appears probable that they will soon apply this method in their space program, especially in view of discouraging results obtained by means of E.E.G. monitoring. Apart from this information, received personally by this Investigator, it is worthwhile to note the statement of Moskalenko and Naumenko in "Cerebral Ischemia" edit. Simonson & Mc Gavack, 1964, page 22: ..."For the registration of the dynamics of blood supply to the cranial - cerebral cavity the best of existing methods is electroplethysmography (EPG) (in American literature: impedance plethysmography; in Austrian and German literature: rheography) which is based on an analysis of variation in the electrical conductivity of the tissues." Similar views were expressed to this Investigator by two prominent American authorities in cerebral circulatory research, drs. S.S. Kety and L. Sokoloff, in discussing clinical application.

Proposed research:

This Investigator hopes that his two new proposals will obtain early consideration. NASA's support of this work will enable him to continue his research and to maintain this country's lead in rheoencephalography.

Proposal I - "Monitoring of cerebral circulatory response to various conditions" - no: SC #21-017-(001)

Proposal II - "Warning device in monitoring and telemetering of circulatory changes in the human and animal brain" - no: SC #21-017-(002)